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Enhancement of the Accretion of Jupiter's Core by a Voluminous Low-Mass Envelope

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We present calculations of the early stages of the formation of Jupiter via core nucleated accretion and gas capture. The core begins as a seed body of about 350 kilometers in radius and orbits in a swarm of planetesimals whose initial radii range from 15 meters to 100 kilometers. We follow the evolution of the swarm by accounting for growth and fragmentation, viscous and gravitational stirring, and for drag-induced migration and velocity damping. Gas capture by the core substantially enhances the cross-section of the planet for accretion of small planetesimals. The dust opacity within the atmosphere surrounding the planetary core is computed self-consistently, accounting for coagulation and sedimentation of dust particles released in the envelope as passing planetesimals are ablated. The calculation is carried out at an orbital semi-major axis of 5.2 AU and an initial solids' surface density of 10/g/cm^2 at that distance. The results give a core mass of 7 Earth masses and an envelope mass of ~ 0.1 Earth mass after 500,000 years, at which point the envelope growth rate surpasses that of the core.
The same calculation without the envelope gives a core mass of only 4 Earth masses.